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"Contribution to the Study of the Vertebrate Liver." By SHERIDAN DELÉPINE, M.B. Edin. Communicated by T. LAUDER BRUNTON, M.D., D.Sc., F.R.S. Received November 20, 1890.

(Abstract.)

Preliminary Remarks.—The following observations were made at the end of last year in the course of an investigation *touching the action of drugs* on *cellular structure* carried out by Dr. Lauder Brunton and myself, for the Royal Society.

Arrangement of the Hepatic Columns in a Classical Liver Lobule.—The following arrangement is visible in a plane perpendicular to the direction of the terminal vessels occupying the centre and the periphery of such a lobule. The columns of cells extend radially round the hepatic veins only in the direction of the portal veins, that is, in three, four, or five directions at most. In the intermediate region the columns present a typical feathery arrangement. The line from which the columns diverge will be called hereafter *hepatic line of divergence.* A similar arrangement is found around the terminal portal veins, giving rise to what I call *portal lines of divergence.*

Towards *the portal lines of divergence* the columns of cells become smaller in diameter, and join each other, becoming continuous with narrow tubes lined with flat epithelium and having the character of *intermediate tubes.* These narrow channels open into more distinct *terminal bile ducts.*

Arrangement of the Bile Canaliculi.—The liver columns branch from the portal lines of divergence towards the hepatic lines. This branching is, however, generally obscured by lateral anastomoses, but it becomes more evident when the bile canaliculi are distinct.

Two sets of bile canaliculi may be recognised:

1. The *main canaliculi*, occupying the axis of the columns of cells and becoming comparatively wide in the portal zone; it is the branching of these which renders that of the columns so evident in some specimens.

2. The *lateral canaliculi*, which pass between the cells forming the walls of the main canaliculi.

In addition to these two sets of passages an *intracellular branched system of lacunæ* may be described as forming the rootlets of the canaliculi. These spaces open directly into the canaliculi, and have been previously partly described by Pflüger and Kupffer.

Description of a True, Secretory, or Primary Lobule.—From what precedes it follows that the liver tubes, instead of being grouped round the terminal hepatic veins, are distinctly arranged in *small pyramidal masses, which correspond to the lobules of other glands.* These lobules are composed of the tubules diverging from the intermediate tubes found in the portal line of divergence, each set of intermediate tubes opening into a terminal bile duct. An arrangement somewhat analogous had already (in 1882) been supposed to exist by Sabourin, but he had been unable to discover in healthy livers what he believed to exist and had been obliged to fall back upon diagrammatic representations which are not altogether correct.

Development of the Liver.—Eberth and other observers since have recognised that the embryonic liver is composed of *hypoblastic tubes* branching in a mass of *mesoblast.* This being common to the liver and all other glands does not explain the differences between these organs. Between the third and sixth weeks of embryonic life (in man) nearly the whole of the mesoblastic tissue separating the hypoblastic columns becomes transformed into embryonic veins full of blood. In other glands only a small part of that tissue becomes transformed into veins, the greater part remaining in the shape of interlobular and interlobar tissue. In the liver, therefore, the hepatic veins take the place of the greater part of the stroma of other glands.

It is only around the oldest hypoblastic tubes which become ultimately ducts, and at the periphery of the organ, that a little mesoblastic tissue becomes transformed into fibrous connective tissue (Glisson's capsule).

Structure of the Hepatic Cells.—The *mitoma* gives unmistakable evidence of a further differentiation of parts of the trabeculæ composing it. These trabeculæ are contractile.

The *paramitoma* is enclosed in the meshes formed by the mitoma, and is the chief seat of the anabolic and katabolic changes taking place in protoplasma. The products thus formed probably under the influence of the mitoma accumulate in the midst of the paramitoma; when soluble, they permeate it; when insoluble, they are precipitated in the shape of drops or vacuoles, globules, granules, crystals. For these products only the name of *Paraplasma* should be reserved.

In the paraplasma two kinds of elements may be recognised, namely:—(1) those resulting from the katabolic process of the cell or other tissues (kataplasma), *e.g.*, bile pigment; (2) those resulting from the *anabolic processes* (anaplasma), *e.g.*, glycogen In the

paramitoma of the liver cells the following anaplastic and kataplastic products may be demonstrated easily:—serous fluid (vacuoles) bile pigment, pigment containing iron, glycogen, fat, &c.

[It is to be remembered that, soon after the discovery of lobules in the pig's liver by Wepfer (1664), Malpighi (1666) described these lobules as being appended to the extremities of the vessels contained in Glisson's capsule. Ferrein (1749) showed that the liver, like other glands of the body, had a tubular structure; but, as he included the spleen among the tubular glands, it may be doubted whether he did more than generalise on the basis of his observations on the kidney. Three years before the publication of Kiernan's paper, Müller seems to have noticed the pinnate arrangement to which I have given the name of "portal lines of divergence;" but there can be little doubt as to the general acceptance of Kiernan's views after the publication of his observations in 1833 ('Philosophical Transactions'). The work of Kiernan was in great part based on the result of injections through the vessels.

For an account of the history of the subject, I would refer the reader to Kiernan's admirable paper, in which a great many points which I have purposely left aside will be also found mentioned.—Dec. 17, 1890.]

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